

SELF-REGULATED LEARNING OF ARCHITECTURAL DESIGN PROFESSIONALS IN TAIWAN

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ABSTRACT

Architectural design professionals in Taiwan are responsible for controlling the construction quality of the entire architecture, they must understand knowledge of professionals that including cross-disciplinary knowledge and new fields that require understanding following changes in the environment, are constantly increasing. Hence, it is important for professionals to continuously and autonomously learn knowledge required for their line of work under their immense work pressure, so that their expertise in architectural design may continue to improve. This study designed a questionnaire from a meta-cognitive perspective of individuals' learning process or how they learn. The questionnaire is first examined by experts for content validity, in which 51 questionnaires were issued and collected to test reliability and validity. The questionnaire was then randomly issued to 200 architectural design professionals working in architect office in Taipei City, of which 171 effective questionnaires were collected. The attitude and general condition of architectural design professionals with respect to Self-Regulated Learning is examined from three perspectives: personal, behavior, and environment. Finally, recommendations for improving Self-Regulated Learning ability are offered to education institutes of architectural design talent based on analysis results. Research results indicate that in terms of professional learning items, professionals most commonly learned about architectural design, but learned relatively less about construction management. From a personal perspective, most professionals enthusiastically and actively learned about new specialties, and understood their own characteristics when choosing a suitable learning method, constantly self-examining in the learning process, but lacked perseverance in learning. From a behavioral perspective, most professionals learned through discussion with their colleagues, as well as actual operations, and would autonomously adjust the direction of their learning, but lacked the ability to formulate learning plans and analyze contents. From an environment perspective, most professionals did not rely on assistance from the outer environment, and were able to access information through various channels.

KEYWORDS: *Self-Regulated Learning, Architectural Design Professionals, Meta-Cognitive, Architect Office & Education Institutes*

Received: Mar 10, 2017; Accepted: Mar 28, 2017; Published: Apr 04, 2017; Paper Id.: IJESRAPR201714

INTRODUCTION

Background

Self-regulated learning (SRL) is an important topic in educational psychology that applies meta-cognition or cognition about cognition, i.e. our understanding of our own cognitive processes. It generally refers to each individual's regulation of their own cognition of learning in education and various learning processes (Wang, C. H., 2005); meta-cognition is a model for self-monitoring of our cognition, and meta-cognitive knowledge and experience interacts with learning goals, actions or strategies in the cognition monitoring process (Flavell, John H., 1979). Moos, D. C. & Bonde, C. (2016) The concept of SRL involves individuals setting learning goals,

motivation, behavior, self-monitoring and regulation of cognition, and actively utilizing strategies to construct knowledge and achieve learning goals. T. Bidjerano, D.Y. Dai. (2007) the theory of SRL originated from psychological research on self-control, and models of SRL are mostly based on Bandura, A. (1986) social cognitive theory. Extending this theoretical foundation, Zimmerman proposed that SRL is a continuous circulation of three key factors, namely individual, behavior, and environment. As shown in Figure 1, Zimmerman, B.J. (2000) SRL involves constant thinking, experience, and action in the learning process to achieve personal learning goals. Wang, C. H. (2005) When an individual gains an initial learning experience and knows how it feels to learn, the regulation of goals and strategies will allow the individual to adapt to changes in the individual, behavior, and environment throughout the learning process, being able to effectively regulate accordingly to any degree of change to reach expected goals and outcomes. This self-regulation cycle in learning helps achieve lifelong learning objectives.

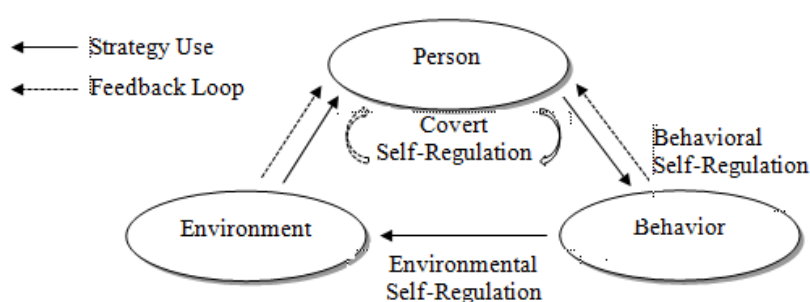


Figure 1: Triadic Forms of Self-Regulation.

Sources: Zimmermann, B.J., p.15. (2000). Attaining self-regulation: a social cognitive perspective. & Zimmermann, B. J., p.330. (1989). A social cognitive view of self-regulated academic learning.

In Taiwan, architectural design and construction supervision may only be performed by architects that passed the national examination. With consideration to building and construction safety and quality, there are strict requirements on the practice of architecture. Architecture firms do not operate in the form of a typical company. Due to the environment in Taiwan, most architecture firms are small and medium sized firms, and extremely few are large scale architecture firms. Most of the firms are concentrated in urban areas. According to statistics of the Ministry of the Interior, there were 3,959 architects in 2015, of which 3,833 were in practice. A related report pointed out that 93.51% of architecture firms in Taiwan have 10 or less employees. Based on the statistics above, architects in Taiwan cannot effectively divide their work contents due to the limited scale of architecture firms. In other words, from initial architectural planning and design to on-site construction supervision, architects must shoulder the responsibility of overall architectural design and construction quality control, and the specialized knowledge that is needed covers all architecture related technical services. Moreover, cross-disciplinary knowledge and new fields that require understanding following changes in the environment, e.g. BIM (Building Information Modeling), green buildings, and smart buildings, are constantly increasing. Hence, it is important for professionals to continuously and autonomously learn knowledge required for their line of work under their immense work pressure, so that their expertise in architectural design may continue to improve.

Motivation

Problem finding and problem solving abilities are needed abilities in the workplace. The work of architectural design professionals not only requires understanding of spatial, aesthetic and application related laws and regulations, but also structure, equipment integration, materials, and construction methods. They also need to face new demands that arise

from changes in the external environment, including demands on environment sustainability, a topic with growing public awareness (James, Wang, 2013). In terms of learning specialized knowledge, the application of SRL, practice from routine work and reflection on learning problems are important factors that often allow them to continue making improvements and innovation (Allison Littlejohn, Colin Milligan, Rosa Pia Fontana, & Anoush Margaryan., 2016). However, how do architectural design professionals engage in SRL in the practice of routine work? Survey studies answering this question are currently lacking. Therefore, this study ascertains the current situation and issues with SRL of specialized knowledge by architectural design professionals in the work process.

Purpose

Based on the background and motive described above, this study ascertains the application of SRL in the workplace by architectural design professionals in Taiwan for learning specialized knowledge, and offers recommendations to education institutions for cultivating specialized talent based on the analysis results. The purpose of this study is as follows:

- Survey and understand specialized work items in which architectural design professionals apply SRL.
- Survey and understand the individual and behavior and environment of architectural design professionals when applying SRL in work.
- Summarize and analyze survey results, and offer recommendations for education institutions cultivating specialized talents.

METHODS

This study designed the questionnaire based on the concepts of SRL and the triadic forms of self-regulation. Research subjects are architectural design professionals in architecture firms in Taipei City, and the questionnaire provides a basis for understanding how they apply SRL at work. The questionnaire is first reviewed by 8 education experts and scholars for content validity based on the semantics and contents of questions. After revising the questionnaire according to the opinions of the experts and scholars, 51 questionnaires were issued to test for reliability. Once the reliability and validity of the questionnaire was determined, the formal questionnaire was issued to randomly selected subjects, and results were put through statistical analysis (Cronbach's alpha was 0.732, indicating good reliability, as shown in Table 1. KMO was 0.838, indicating good validity and suitable for factor analysis, as shown in Table 2) to examine issues with SRL of specialized knowledge at work.

Table 1: Reliability Statistics

Cronbach's Alpha	Number of Items
0.732	17

Table 2: KMO & Bartlett Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.838
Bartlett Test of Sphericity	Approx. Chi-Square	909.657
	df	136
	significant test	0.000

Subject

This study chooses employees of architecture firms that provide architecture related technical services, i.e. employees responsible for architectural planning, design, project integrated management, and construction supervision, and randomly selects architecture firms in parts of Taipei City for the questionnaire survey. A total of 200 questionnaires were sent out and 180 questionnaires were collected, in which 9 questionnaires were ineffective and 171 effective questionnaires were collected. Research results examine the SRL of related personnel from three aspects, namely individual, behavior, and environment. Finally, concrete recommendations are proposed for education institutions cultivating architectural design talent based on the analysis results, so as to improve their development of SRL ability.

Research tool

The research tool used in this study is the “Questionnaire on SRL of Architectural Design Professionals,” which consists of two parts:

Introduction and Basic information

An introduction describing the nature and purpose of this study is provided on the first page for the questionnaire survey to be successfully carried out; contents of the introduction:

Dear Architecture Firm Professionals

First of all I would like to thank you for taking the time to fill out this questionnaire on “self-regulated learning of architectural design professionals.” The main purpose of this study is to understand the awareness and outcomes of self-regulated learning by architectural design professionals of different sex, age, academic background, and work experience. This study also surveys the current situation of self-regulated learning by architectural design professionals when facing work challenges and the continuous increase in specialized knowledge.

Your opinion will serve as reference for architectural design academia and industry in teaching specialized talents and on-the-job learning, allowing architectural design professionals to more efficiently learn specialized knowledge and skills and contribute what they learn so they are not eliminated by the rapidly changing environment.

This questionnaire will only be used for academic research and the data will be strictly confidential. Your answers are precious data to this study. Thank you for your cooperation and support.

Personal information includes specialized items in which SRL is applied

Academic background	(1)Vocational school	(2)Junior college associate degree	(3)Technology college/university bachelor degree
	(4)Regular university bachelor degree	(5)Technology university master's degree	(6)Regular university master's degree
	(7)Technology university doctors degree	(8)Regular university doctors degree	(9)Other:
Specialized items you will apply self-regulated learning at work (multiple choice):	(1)Architectural design	(2)Architectural law	(3)Construction management
	(4)Software for professionals	(5)Building material characteristics and applications	(6)Other:

Evaluation of SRL of Specialized Knowledge at Work

Items of the questionnaire related to specialized work of architectural design are designed based on the three key factors of SRL, namely individual, behavior, and environment. Items are evaluated on a five-point scale, in which 1.strongly disagree, 2.disagree, 3.sometimes agree, 4.agree, and 5.strongly agree. Simple of items are listed in Table 3 below:

Table 3: Items of Questionnaire on SRL at Work

Category	Code	Item	Contents
Individual	QP001	1	I understand my <u>personality traits</u> and can choose a suitable self-regulated learning method accordingly
Behavior	QA001	9	I can <u>independently set</u> the direction and plans for self-regulated learning
Environment	QE001	8	I need <u>regular announcements in my workplace</u> for information on new specialized knowledge

Data Analysis

After the questionnaires were collected, they were coded and input into the computer, using SPSS19 and Excel2013 for statistical analysis. Subjects were divided based on regular education system and vocational education system. Descriptive statistics was adopted for reviewing distribution of samples, mean, and standard deviation. Furthermore, the actual population cannot be determined for finding a reasonable sample size in this study. Hence, nonparametric tests of Mann-Whitney tests are adopted for determining the significance of differences. Finally, the abovementioned statistical results are coded and summarized for research analysis and the conclusion and recommendations are proposed on this basis.

RESULTS

The effective questionnaires on “SRL of architectural design professionals at work” were collected. This study divides subjects by regular education system and vocational education system based on the statistical results, and analyzes the data by SRL of specialized knowledge at work, person aspect of SRL, behavior aspect of SRL, and environment aspect of SRL.

SRL of Specialized Knowledge at Work

Specialized knowledge that architectural design professionals learn at work is discussed based on statistical results to understand the current situation of SRL of specialized knowledge at work. Results of the questionnaire survey are shown in Table 4.

Table 4: Item of Autonomy Learning in Professional Work

		Responses		Percent of Cases
		Number	Percent	
Item of autonomy learning in professional work	1.Architectural Design	143	26.1%	84.1%
	2.Architectural Law	130	23.8%	76.5%
	3.Construction Management	54	9.9%	31.8%
	4.Software for Professional	130	23.8%	76.5%
	5.Building materials	90	16.5%	52.9%
Total		547	100.0%	321.8%

The total number of specialized items that professionals applied SRL at work was 321.8% the number of subjects, showing that most subjects selected more than three items listed in the questionnaire, in which subjects mainly learned Architectural Design (26.1%), Architectural Law (23.8%), and Software for Professionals (23.8%); 16.5% of subjects selected Building materials, which affects detailed designs, and only 9.9% of subjects selected Construction management, which is after the building construction stage begins. This indicates that subjects still focus on preliminary planning and design and building permit application when learning at work.

This may be due to most architecture firms defining their role as completing building permit application, and choose to rely on other professionals for assistance in detailed design and construction management. When handling a privately contracted construction project, most clients that are relatively large companies will divide labor by specialization, and there are relatively few issues in execution, but when it is a public construction that does not have a professional construction management company (PCM) or construction projects of personal, repeat contracting and horizontal and vertical communication and management gaps between construction units can easily occur due to insufficient familiarity with related specialized knowledge, and architectural design concepts cannot be implemented in the architecture.

Personal perspective

Questionnaire items related to individual cognition of SRL are as follows:

QP001. I understand my personality traits and can choose a suitable self-regulated learning method accordingly.

QP002. I will think back over my learning process and experience.

QP003. I am curious and crave new specialized knowledge and skills.

QP004. I have a positive attitude towards learning new specialized knowledge and skills.

QP005. I have perseverance in learning new specialized knowledge and skills.

QP006. I still need others to help remind me of my learning issues and problem solving techniques in the learning process.

QP007. I can independently find information of new specialized knowledge and have interest in gaining further understanding.

Survey results are shown in Table 5.

Table 5: SRL in Professional Work, The Part of Personal Cognition

Item Code	Mean			SD	Overall Rank	Z	Significance	< A
	Vocational Education System	Regular Education System	Total					
QP001	3.57	3.70	3.63	0.744	7	-1.113	0.266	
QP002	3.78	3.82	3.80	0.650	3	-0.377	0.706	
QP003	3.81	4.00	3.89	0.715	1	-1.853	0.064	
QP004	3.76	3.85	3.80	0.677	3	-0.852	0.394	
QP005	3.48	3.49	3.49	0.706	12	-0.005	0.996	

QP006	3.66	3.51	3.58	0.925	10	-1.257	0.209	
QP007	3.51	3.75	3.61	0.697	9	-2.17	0.030	*
Simple	98	73	171					

Remark: $\rho < 0.05 = *$; $\rho < 0.01 = **$, shown for Indicates significant difference

With regard to individual cognition of SRL of specialized knowledge at work, subjects had relatively positive responses in all items, in which the highest was curiosity and crave for new knowledge (mean of 3.89), followed by positive attitude and thinking back on the learning process (mean of 3.80); perseverance in learning was the lowest (mean of 3.49), but still a positive response. This shows that most subjects have a relatively weak understanding of this aspect. The mean score for being able to independently find new knowledge and have interest in gaining further understanding was 3.61, in which responses of subjects from the regular education system (mean of 3.75) was higher than subjects from the vocational education system (mean of 3.51); level of significance was $0.030 < 0.050$, indicating a significant difference. This may be due to most subjects having a positive attitude towards SRL of new specialized knowledge at work. This learning motivation may be generated from a sense of achievement after improving their work performance. Subjects generally had lower perseverance in learning, which may be due to their busy work schedules affecting their intention to continue learning. In finding new knowledge, subjects that graduated from the regular education system have a more positive attitude than subjects that graduate from the vocational education system.

Behavioral Perspective

Questionnaire items related to behavior in SRL are as follows

QA001.I can independently set the direction and plans for self-regulated learning.

QA002.I learn new specialized skills through hands-on operation.

QA003.I will acquire data for learning specialized knowledge and skills through various channels.

QA004.I can independently integrate learning data and categorize the data for analysis and better understanding.

QA005.In the learning process, I will independently adjust the direction and contents of learning.

QA006.I will discuss and exchange new specialized knowledge and skills with my colleagues.

Survey results are shown in Table 6.

Table 6: SRL in Professional Work, the Part of Behavioral

Item Code	Mean			SD	Overall Rank	Z	Significance	<A
	Vocational Education System	Regular Education System	Total					
QA001	3.04	3.10	3.06	0.798	14	-0.322	0.747	
QA002	3.62	3.77	3.68	0.707	6	-0.997	0.319	
QA003	3.57	3.71	3.63	0.796	7	-0.995	0.32	
QA004	3.38	3.70	3.51	0.762	11	-2.737	0.006	**
QA005	3.58	3.84	3.69	0.705	5	-2.571	0.010	*
QA006	3.84	3.86	3.85	0.744	2	-0.05	0.960	

Simple	98	73	171					
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Remark: $p < 0.05 = *$; $p < 0.01 = **$, shown for Indicates significant difference

With regard to behavior in SRL of specialized knowledge at work, subjects had a neutral response to the ability to independently set learning directions and plan (mean of 3.06), but had relatively positive responses to other items. Subjects had the most positive response to discussion and exchange of specialized knowledge and skills with colleagues (mean of 3.85), followed by independently adjust learning directions and content (mean of 3.69) and hands-on operation of learning (mean of 3.68); subjects also had a relatively positive to gaining specialized knowledge through various channels (mean of 3.63). In the independent adjustment of learning direction and contents, subjects that graduated from the regular education system (mean of 3.84) had more positive responses than subjects that graduated from the vocational education system (mean of 3.58), in which level of significance $0.010 < 0.050$ indicates a significant difference. In independently integrate learning data and categorize the data for analysis and better understanding, the overall mean was 3.51, a relatively positive response, but subjects that graduated from the regular education system (mean of 3.70) had more positive responses than subjects that graduated from the vocational education system (mean of 3.38), in which level of significance $0.006 < 0.010$ indicates a significant difference.

This result may be due to the inclination of subjects towards peer learning with respect to behavior in SRL of specialized knowledge at work. Adjustment of learning direction along with the environment and hands-on operation are also subjects' learning habits. This may be due to subjects working in an environment with mostly cooperation and not competition, and their main consideration in work achievement developed into skilled professional performance and problem solving at work. In the adjustment of learning direction and contents, as well as integrated analysis of learning data, subjects that graduated from the regular education system had more positive responses than subjects that graduated from the vocational education system. However, all subjects had a neutral response to independently setting learning direction and plans, and may be due to relatively less training with setting learning plans in their learning process. This may also be related to the volatile and busy workplace they work in, where plans can never keep up with change, and the specialized knowledge they learn must be immediately applied in work. Hence, subjects are in the habit of resolving the issue at hand when learning specialized knowledge, and lack a comprehensive learning plan. Consequently, the specialized knowledge they learn may be spread out and incomplete, and they will require other methods to complete their learning.

Environment perspective

Questionnaire items related to environment of SRL are as follows:

QE001.I need regular announcements in my workplace for information on new specialized knowledge.

QE002.I still depend on professional education institutions for learning data and instructions.

QE003.I only learn new specialized knowledge and skills when required by my workplace.

QE004.I need my workplace to provide learning funds before learning.

Survey results are shown in Table 7.

Table 7: SRL in Professional Work, the Part of Environment

Item Code	Mean			SD	Overall Rank	Z	Significance	<A
	Vocational Education System	Regular Education System	Total					
QE001	3.23	2.79	3.02	0.914	15	-2.507	0.012	*
QE002	3.20	3.03	3.11	0.946	13	-2.381	0.017	*
QE003	3.08	2.96	3.01	0.898	16	-1.42	0.156	
QE004	2.76	2.33	2.55	1.012	17	-3.078	0.002	**
Simple	98	73	171					

Remark: $p < 0.05 = *$; $p < 0.01 = **$, shown for Indicates significant difference

With regard to the environment for SRL of specialized knowledge at work, the questionnaire items are negative and responses are neutral or disagree, in which subjects disagreed the most with only learn when learning funds are provided (mean of 2.55), followed by only learning specialized knowledge required for work (mean of 3.01) and only gain information of new knowledge from regular announcements in the work place (mean of 3.02); subjects' response to depending on professional education institutions for learning data and instructions was neutral (mean of 3.11). Besides the item only learns specialized knowledge required for work, subjects that graduated from the regular education system gave significantly lower responses than subjects that graduated from the vocational education system.

Responses to items in the part show that SRL of architectural design professionals may be motivated by work performance, and subjects all had a positive learning attitude and behavior, only some subjects still depended on professional education institutions for learning data and instructions; most subjects were able independently achieve learning without depending on the environment. Compared with subjects that graduated from the regular education system, subjects that graduated from the vocational education system had relatively higher demand on incentives from the environment for learning motivation.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The current situation and issues of SRL of specialized knowledge by architectural design professionals at work can be found from the research results, which are summarized below:

SRL of Specialized Knowledge at Work

Specialized knowledge that architectural design professionals most commonly learn are architectural laws followed by software for professionals, which are contents in the planning and permit application stage before actual building construction begins. Subjects paid less attention to building materials and construction management during the construction stage, showing that the work of architecture firms in Taiwan still mainly focus on front-end operations, and may result in a communication gap with the construction company when solving problems at the construction site or implementing construction management. This will easily result in the design concept not be properly implemented.

Summary of SRL by Architectural Design Professionals at Work

From an individual perspective, most subjects enthusiastically and actively learned new specialized knowledge, and understood their personality traits for choosing a suitable SRL method. They also thought back on their learning process, but lacked perseverance in learning. From a behavior perspective, most subjects engaged in discussion and exchange with their colleagues, learned through hands-on operation, and independently adjusted their learning direction and contents, but they lacked the ability to set learning plans and analyze content. From an environment perspective, most subjects did not depend on the outer environment for assistance, and were able to independently gain learning information through various channels, but some subjects still depended on professional education institutions for providing learning data and instructions for gaining specialized knowledge.

In general, subjects that graduated from the regular education system were more active and organized than subjects that graduated from the vocational education system, which may be the result of different training in their learning process. The vocational education system is more pragmatic and focuses on actual technology applications, while the regular education system emphasizes methods for learning knowledge in hopes that students will continue to use the methods to improve their specialized knowledge after entering the workplace. Different focuses of learning has advantages and disadvantages, and depends on the individual's self-expectations for professional achievement. However, in terms of SRL skills at work, the vocational education system can still make slight adjustments based on this research result.

Recommendations

The work performance of architectural design professionals affects the results of overall architectural design and construction quality control. Continuously improving specialized knowledge of architecture at work is the key to continued professional improvement and growth of architectural design professionals. Based on the SRL results of architectural design professionals at work, this study proposes the following recommendations:

School Education can focus on Learning and Training of Collaboration and Plan Formulation Abilities of Students

When architectural design professionals are performing their work, the ability to formulate implementation plans for construction projects, communicate and collaborate with other professionals and the Construction Company, and support and learning between peers will greatly benefit their work efficiency. Results of this study show that subjects are in the habit of engaging in discussion and exchange with their peers in SRL, but are less capable of setting learning directions and plans. Hence, the study recommends departments that cultivate architectural design talents to focus on learning and training of students' collaboration, communication and plan formulation abilities, allowing students to build team spirit and systematic plan formulation ability from their interactions with other students in learning.

The Vocational Education System should Focus on Training Students' SRL Ability

In terms of the current workplace for architectural design professionals in Taiwan, their work cannot be divided into detail due to limitations of the market and company scale, and professionals are required to be able to handle the entire architectural design project. Professional training of the vocational education system focus on technology application and hands-on operation in learning skills and knowledge, emphasizing gaining knowledge through the body, but relatively lacking practice in independent exploration of knowledge. This study found that responses of subjects that graduated from the vocational education system were generally lower than subjects that graduated from the regular education system.

Hence, this study recommends that departments cultivating architectural design talents in the vocational education system provide training for students to independently search, understand, and organize knowledge; use theme-based lessons to guide students instead of lectures in class, so that students can develop SRL ability from systematic guidance and instructions.

Vocational Training Institutes can Provide Systematic Courses for Professional Requirements

The work of architectural design professionals not only includes architectural project planning and design and building permit application, but also integration of other specialties and construction quality control. This study found that specialized knowledge architectural design professionals learn at work are still mainly in the design and permit application stage before construction begins, and relatively less attention is paid to construction management. Additionally, in the learning process of specialized knowledge, subjects lack systematic planning of their learning, which is perhaps due to their busy work. Hence, this study recommends that vocational training institutes systematically plan courses (or online lessons) on construction management, which is required by architectural design professionals but relatively lacking, giving architectural design professionals the opportunity to improve their professional capabilities through systematically planned courses during their busy schedules.

ACKNOWLEDGMENTS

I am grateful to National Taipei University of Technology of professor Tsung-Jung Wang for his guided and advice, and also thanks to the study participants for their time.

REFERENCES

1. Allison Littlejohn, Colin Milligan, Rosa Pia Fontana, & Anoush Margaryan. (2016). *Professional Learning Through Everyday Work: How Finance Professionals Self-Regulate Their Learning*. *Vocations and Learning*, 9(2), 207–226.
2. Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
3. Construction and Planning agency ministry of the interior, R.O.C. (2016). *Business News*. Retrieved from http://www.cpami.gov.tw/chinese/index.php?option=com_content&view=article&id=10086&Itemid=53from%EF%BC%9ACo%20nstruction%20and%20Planning%20agency%20ministry%20of%20the%20interior%20ROC
4. Construction and Planning agency ministry of the interior. ROC (2016). *Architects Act*. Retrieved from <http://glrs.moi.gov.tw/EngLawContent.aspx?Type=E&id=282&Keyword=%E5%BB%BA%E7%AF%89%E5%B8%AB%E6%B3%95>
5. Flavell, John H. (1979). *Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry*. *American Psychologist*, 34(10), 906–911.
6. James, Wang., (2013). *Challenging ICT Applications in Architecture, Engineering, and Industrial Design Education*. United States of America : Engineereing Science Reference (an imprint of IGI Global).
7. Ministry of Economic Affairs, R.O.C. (2016). *Taiwan Financial Review*. Retrieved from <http://www.twbusinessnet.com/epaperArticle.do?id=242974723>
8. Moos, D. C. & Bonde, C. (2016). *Flipping the Classroom: Embedding Self-Regulated Learning Prompts in Videos*. *Technology, Knowledge and Learning*, 21(2), 225–242.
9. T. Bidjerano, D.Y. Dai. (2007). *The relationship between the big-five model of personality and self-regulated learning strategies*. *Learning and Individual Differences*, 17, 69–81.
10. Wang, C. H., (2005). *Self-Regulated Learning*. *T & D*, 183, 1–17.
11. Zimmermann, B. J. (1989). *A social cognitive view of self-regulated academic learning*. *Journal of Educational Psychology*,

- 81, 329–339.
12. Zimmermann, B.J. (1990). *Self-regulated learning and academic achievement: an overview*. *Educational Psychologist*, 25, 3–17
 13. Zimmermann, B.J. (1998). *Academic studying and the development of personal skill: A self-regulatory perspective*. *Educational Psychologist*, 33, 73–86.
 14. Zimmermann, B.J. (2000). *Attaining self-regulation: a social cognitive perspective*. In M. Boekaerts, P. R. Pintrich & M. Zeidner (eds.), *Handbook of Self-regulation*. San Diego, CA: Academic Press.